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(54) Sampling water

(57) In sampling water from mains or air conditioning systems to test for micro-organisms such as legionella, the water is passed through a filter comprising two sections 12, 14 to concentrate the micro-organisms, e.g. on a membrane 30. Section 14 is then unscrewed from section 12 and secured to a collecting chamber (32, Fig. 2) into which the collected micro-organisms are flushed by back-washing. In Fig. 1 membrane 30 is the finest of a series of filter members 22 to 30, but in Fig. 3 a loose bed of polystyrene latex particles with suitable antibodies thereon collects the micro-organisms desired and is thereafter flushed into the collecting chamber. The water can be sampled continuously in a by-pass passage or using a collecting funnel (Fig. 5) or a syringe may collect a series of samples and inject them consecutively through the filter (Fig. 8).

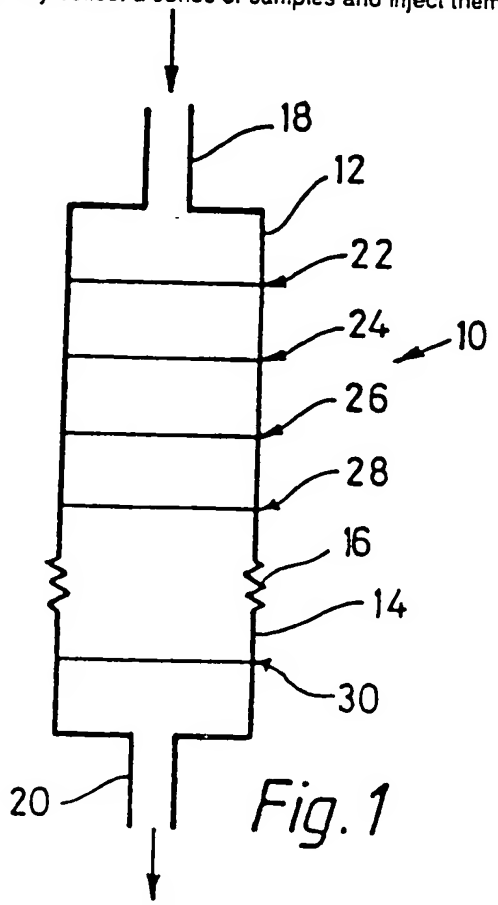

Fig. 1

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Title Improvements in Liquids Sampling

Field of the invention

This invention relates generally to the sampling of liquids and in particular to a method of and apparatus for the sampling of liquids for the purpose of extracting micro-organisms and/or micro-particles which can then be assayed.

Background to the invention

There is a frequent requirement for the sampling of water and other liquids in order to be able to test for the presence of micro-organisms and/or micro-particles. One example of a situation where such sampling is required is in the evaporative cooling tower of a water-circulatory air conditioning system, for the purpose of monitoring the cooling water for the presence of micro-particles and/or micro-organisms such as legionella. Hitherto, sampling has generally been wholly of manual nature, a small container of the water being extracted by hand and taken to the laboratory for testing. The liquid sample extracted in this way is very small, but its condition has to be assumed representative of that of the total liquid in the system. Moreover, the micro-organism or micro-particle content in the sample may be extremely small, which can result in difficult assaying problems and possibly unreliable results.

The invention

According to one aspect of the invention, there is provided a method of sampling a liquid to extract micro-organisms and/or micro-particles, according to which the liquid to be sampled is passed through an entrapment chamber for micro-organisms and/or micro-particles, and at least part of the entrapment chamber is then detached, connected to a collection chamber, and back-flushed with clear liquid to cause the micro-organisms and/or micro-particles which have been trapped in the entrapment chamber to be washed into the collection chamber.

The essence of the invention is therefore to provide a method whereby an accumulation of micro-organisms and/or micro-particles is built up in the entrapment chamber, and this accumulation is then transferred to the collection chamber to provide therein a micro-organism or micro-particle rich sample ready for assaying.

For the purpose of trapping the micro-organisms or micro-particles in the entrapment chamber, the liquid undergoing sampling may either be progressively filtered in said chamber or be attracted within said chamber to a suspended particulate carrying a material which specifically and selectively binds with a species of interest to be detected in the liquid being sampled, e.g. an antibody for a micro-organism or a lectin.

According to another aspect of the invention, there is provided apparatus for carrying out the afore-described method comprising an entrapment chamber formed in two parts detachable from one another, means within the

chamber for trapping micro-organisms and/or micro-particles contained in a liquid caused to flow through the entrapment chamber, and a collection chamber which is connectable to a detached part of the entrapment chamber which retains trapped micro-organisms and/or micro-particles, whereby the trapped micro-organisms and/or micro-particles can be washed into the collection chamber by back-flushing through the detached part of the entrapment chamber into the collection chamber.

In one embodiment, the entrapment chamber contains a series of filters of diminishing mesh size in the direction of flow of the liquid being sampled, the filter of smallest mesh size, which traps the micro-organisms and/or micro-particles entrained in the liquid being sampled, being carried by the part of the entrapment chamber which connects with the collection chamber.

In another embodiment, the entrapment chamber has two micro-porous membranes, one carried by each part of said chamber, and which retain between them in suspension a particulate such as polystyrene latex particles carrying a material which specifically and selectively binds with a species of interest which may be present in the liquid being sampled. Back flushing with clear liquid thus washes the particulate with said species bound thereto into the collection chamber.

The entrapment chamber may be connected in line with or in a bypass with the flow of liquid being sampled. Alternatively, however, it may not be directly connected with the flow of said liquid, but be fed with a series of samples taken by syringe from different parts of the system in which the liquid under test is employed, such as

a water circulatory air conditioning system. This alternative method of use is also applicable, for example, to the testing of water in a mains water reservoir or river water.

Description of embodiments

The method and apparatus in accordance with the invention are exemplified in the following description, making reference to the accompanying drawings, in which:-

Figure 1 shows one embodiment of entrapment chamber;

Figure 2 shows a collection chamber;

Figure 3 shows another embodiment of entrapment chamber;

Figure 4 again shows a collection chamber;

Figure 5 shows several ways of connecting the entrapment chamber in the water circuit of a water circulatory air conditioning system;

Figures 6 and 7 show in diagrammatic manner two possible constructions of entrapment chamber for use in the arrangement of Figure 5; and

Figure 8 shows an alternative manner of use of the entrapment chamber.

Referring first to Figure 1, a sampling or entrapment chamber 10 is formed as a two part filter cartridge, the upper part 12 fitting to but being detachable from the lower part 14 by such means as a screwthread 16. Upper

part 12 has a top inlet 18 for a liquid to be sampled, and the lower part 14 has a bottom outlet 20. A series of filters or membranes of diminishing pore size in the direction of liquid flow are mounted in the chamber 10, for example five filters comprising a coarse grid 22, a 100 micron pore size filter 24, a 10 micron pore size filter 26, a 5 micron pore size filter 28, and a 0.45 micron pore size filter 30 which is located in the lower part 14 of the cartridge and at which it is intended that micro-organisms and/or micro-particles contained in the liquid flow through the cartridge shall be retained.

After a sufficient amount of the liquid being sampled has passed through the cartridge, the flow through the cartridge is stopped, and the lower part 14 containing the smallest pore size filter 30 is disconnected, inverted and fitting.

The filter 30 is now back-flushed with clean, i.e. micro-organism and micro-particle free, water or other liquid, the original bottom outlet 20 of the lower part 14 serving as a top inlet 20A. Micro-organisms and/or micro-particles retained at the filter 30 are thus washed into the collection chamber 32 to provide a sample 36 ready for assaying. Agitation of the clean water introduced into the assembly, as by shaking or other means, may be useful to assist detachment of the micro-organisms and/or micro-particles from the filter 30. The collection chamber 32 has a side arm 38 with a tap for liquid extraction.

Figures 3 and 4 show a modified embodiment, wherein similar references to those used in Figures 1 and 2 are employed for similar parts. In the embodiment of Figures 3 and 4, the filters 24 to 30 are replaced by a particle

compartment 40 containing a particulate maintained in suspension in the liquid flowing through the chamber due to agitation created by the flow, which particulate carries a material which bonds specifically and selectively with a species of interest which may be present in the liquid being sampled, e.g. the micro-organism legionella. The compartment 40 is defined between upper and lower porous membranes 42, 44, the latter membrane 44 being located in the lower part 14 of the chamber. A suitable particulate comprises polystyrene latex particles; these may have covalently linked thereto an antibody or lectin for the particular species of interest. When the flow of liquid being sampled is stopped, the particulate drops on to the membrane 44 so that thereafter when, as indicated in Figure 4, the accumulated sample is back-flushed through the lower part 14 of the entrapment chamber into the collection chamber 32, a sample 46 ready for assaying is collected, said sample containing the particulate with the micro-organisms or micro-particles of interest attached thereto.

Figure 5 shows a water circulatory air conditioning system in diagrammatic manner, the evaporative cooling tower being referenced 50, the cooling baffles 52 and the cooling water pond 54. The water in the system may be sampled by an entrapment chamber generally as above-described connected into the system at any of points 56, 58 or 60.

Figure 6 shows a sampling chamber 62 with spur fittings 64 adapted for connection at the point 56 of the system of Figure 5, whilst Figure 7 shows a sampling chamber 66 having an associated water collection baffle 68, whereby

the device can be located at either of the points 58 or 60 of the system of Figure 5. Arrows 69 indicate an excess water discharge.

However, direct connection of the entrapment chamber with the system containing the liquid to be sampled is not essential. Figure 8 shows an alternative mode of use employing a syringe 70, which is used to extract water or other liquid from different parts of the system being monitored, or any other flow or body of water which is to be tested. The syringe 70 is adapted for discharge directly into the entrapment chamber 72, so that a final sample ready for assaying is obtained derived from the batches of liquid obtained from all points of the system under test. If as a result of an initial assay undesirable micro-organisms or micro-particles are detected, further tests may be made to identify the point or points of the system from which the micro-organisms or micro-particles originate.

The examples of the invention above-described and illustrated may be modified in various ways within the scope of the invention hereinbefore defined.

CLAIMS

1. A method of sampling a liquid to extract micro-organisms and/or micro-particles, according to which the liquid to be sampled is passed through an entrapment chamber for micro-organisms and/or micro-particles, and at least part of the entrapment chamber is then detached, conected to a collection chamber, and back-flushed with clear liquid to cause the micro-organsims and/or micro-particles which have been trapped in the entrapment chamber to be washed into the collecion chamber.

2. A method according to claim 1, wherein the liquid undergoing sampling is progressively filtered in said chamber.

3. A method according to claim 1, wherein the liquid undergoing sampling is attracted within the entrapment chamber to a suspended particulate carrying a material which specifically and selectively binds with a species of interest to be detected in the liquid being sampled.

4. A method according to claim 3, wherein the material binds to legionella.

5. A method according to anyone of claims 1 to 4, wherein the liquid to be sampled is water from a water circulatory air conditioning system.

6. A method according to any one of claims 1 to 4, wherein the liquid to be sampled is water from a mains water reservoir or a river.

7. A method of sampling a liquid to extract micro-organisms and/or micro-particles, substantially as herein described with reference to the accompanying drawings.

8. Apparatus for sampling liquid to extract micro-organisms and/or micro-particles, comprising an entrapment chamber formed in two parts detachable fromm one another, means within the chamber for trapping micro-organisms and/or micro-particles contained in a liquid caused to flow through the entrapment chamber, and a collection chamber which is connectable to a detached part of the entrapment chamber which retains trapped micro-organisms and/or micro-particles whereby the trapped micro-organisms and/or micro-particles can be washed into the collection chamber by back-flushing through the detached part of the entrapment chamber into the collection chamber.

9. Apparatus according to claim 8, wherein the entrapment chamber contains a series of filters of diminishing mesh size in the direction of flow of the liquid being sampled, the filter of smallest mesh size, which traps the micro-organisms and/or micro-particles entrained in the liquid being sampled, being carried by the part of the entrapment chamber which connects with the collection chamber.

10. Apparatus according to claim 8, wherein the entrapment chamber has two micro-porous membranes, one carried by each part of said chamber, and which retain between them in suspension a particulate carrying a material which specifically and selectively binds with a species of interest which may be present in the liquid being sampled.

11. Apparatus according to claim 10, wherein the particulate comprises polystyrene latex particles.

12. Apparatus according to claim 10 or 11, wherein the material binds to legionella.

13. Apparatus according to any one of claims 8 to 12, wherein the entrapment chamber is connected in line with or in a bypass with the flow of liquid being sampled.

14. Apparatus according to any one of claims 8 to 12, wherein the entrapment chamber is fed with a series of samples taken by syringe from different parts of the system in which the liquid under test is employed.

15. Apparatus according to any one of claims 8 to 14, wherein the entrapment chamber is connected in the water circuit of a water circulatory air conditioning system.

16. Apparatus for sampling liquid to extract micro-organisms and/or micro-particles, substantially as herein described with reference to, and as shown in, Figures 1 and 2 of the accompanying drawings.

17. Apparatus for sampling liquid to extract micro-organisms and/or micro-particles, substantially as herein described with reference to, and as shown in, Figures 3 and 4 of the accompanying drawings.

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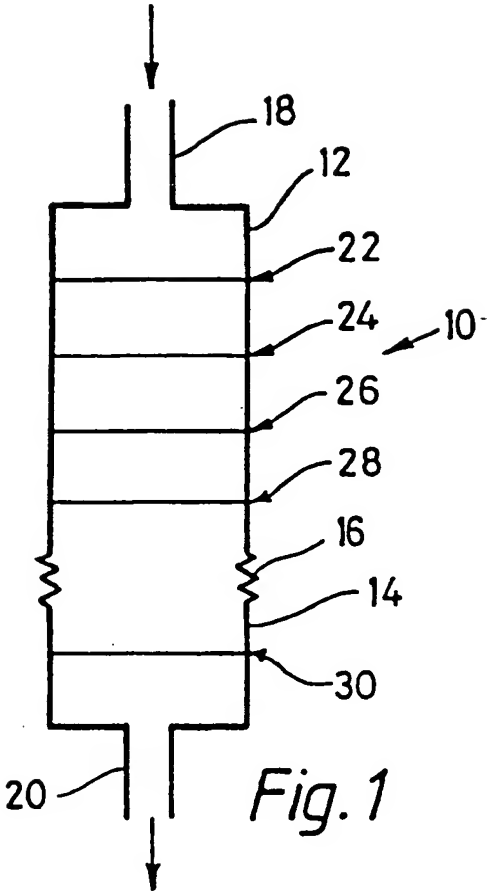

Fig. 1

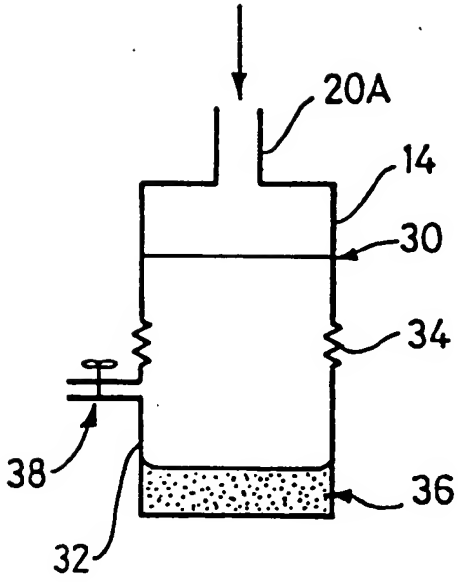

Fig. 2

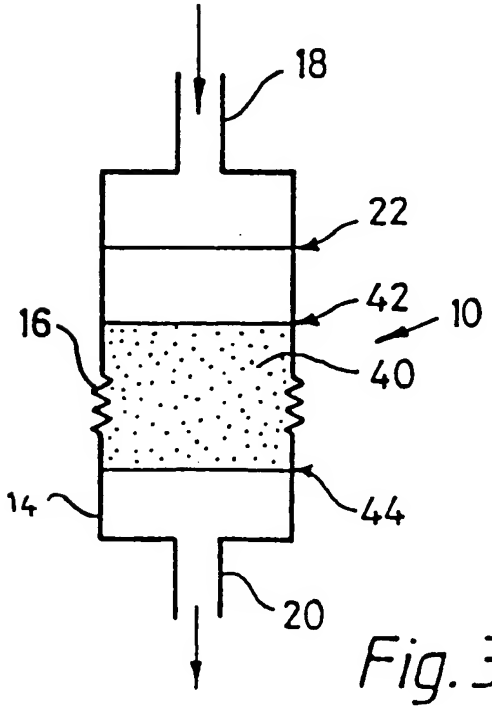

Fig. 3

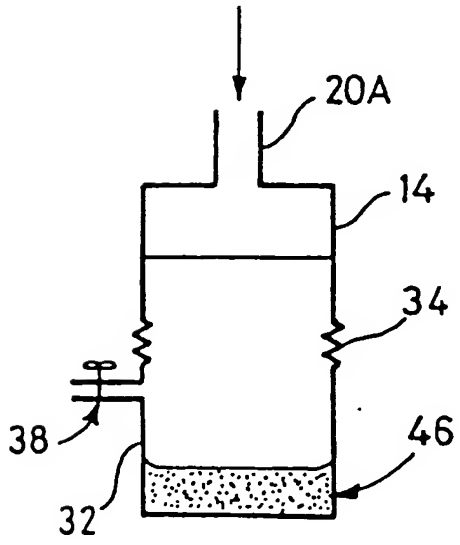

Fig. 4

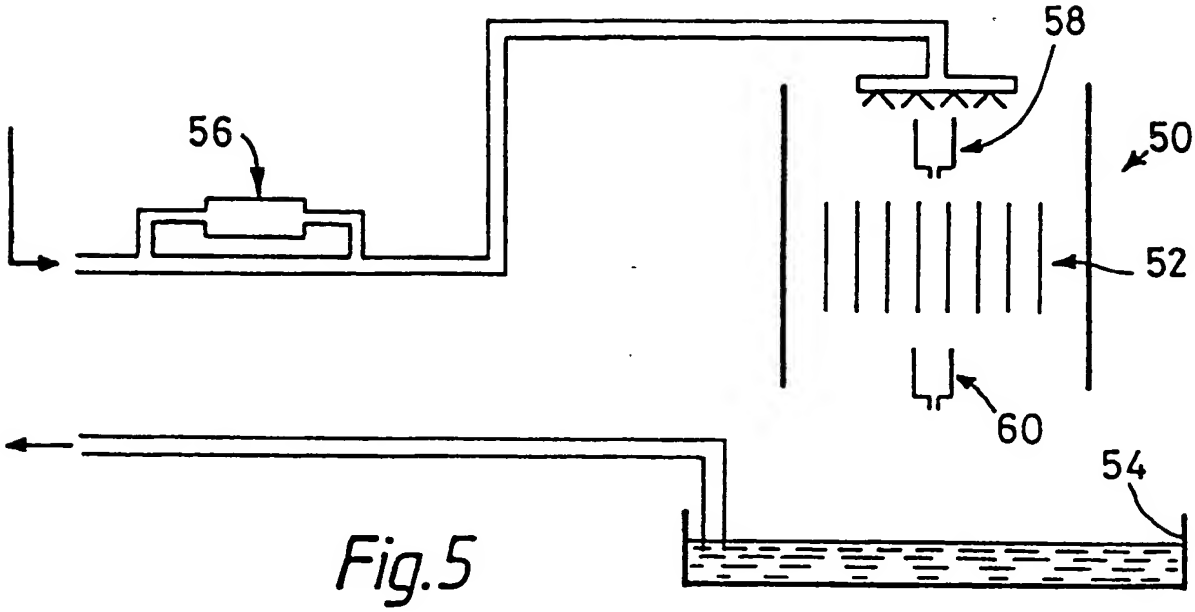

Fig.5

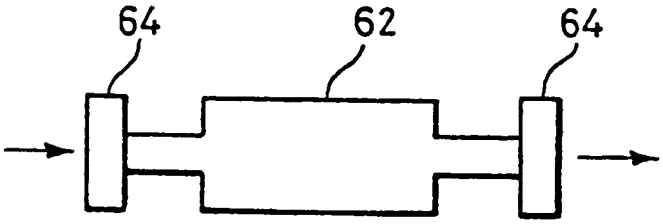

Fig. 6

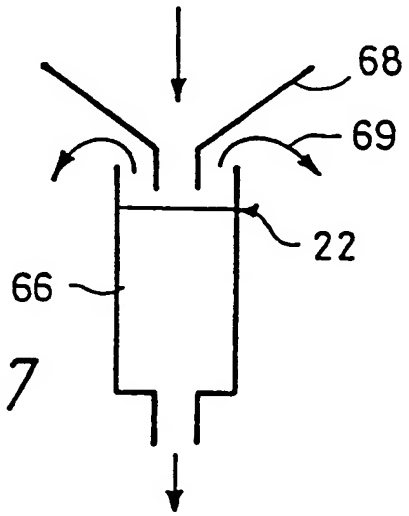

Fig.7

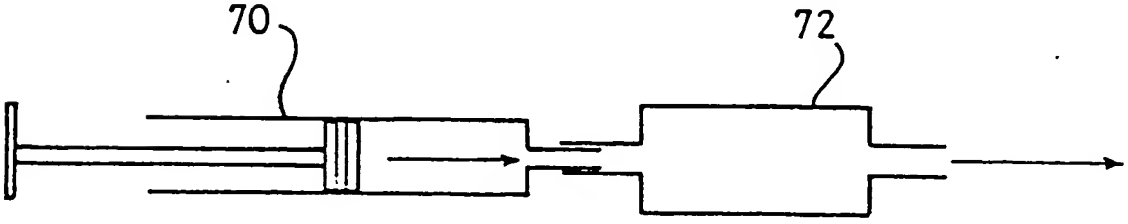

Fig. 8